PATENT
2784-1-001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANTS	:	David John Murphy
SERIAL NO.	:	10/663,563
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FOR	:	CONSTANT DIRECTIVITY ACOUSTIC HORN

PETITION FOR GRANT OF PRIORITY UNDER 35 USC 119

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Applicant hereby petitions for grant of priority of the present Application on the basis of the following prior filed foreign Application:

COUNTRY	SERIAL NO.	FILING DATE
AUSTRALIA	**2002951421**	**SEPTEMBER 17, 2002**

To perfect Applicant's claim to priority, a certified copy of the above listed prior filed Application is enclosed.

Acknowledgment of Applicant's perfection of claim to priority is accordingly requested.

Respectfully submitted,

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Patent Office
Canberra

I, JONNE YABSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2002951421 for a patent by KRIX LOUDSPEAKERS PTY LTD as filed on 17 September 2002.

WITNESS my hand this
Twelfth day of September 2003

J R Yabsley

JONNE YABSLEY
TEAM LEADER EXAMINATION
SUPPORT AND SALES

KRIX LOUDSPEAKERS PTY LTD

AUSTRALIA

PATENTS ACT 1990

PROVISIONAL SPECIFICATION FOR AN INVENTION ENTITLED:-

"CONSTANT DIRECTIVITY ACOUSTIC HORN"

This invention is described in the following statement:-

FIELD OF THE INVENTION

The field of the invention relates to acoustic horns, and more particularly to acoustic horns providing substantially uniform polar frequency-response plots in both the horizontal and vertical directions.

BACKGROUND TO THE INVENTION

An acoustic horn is a structure which utilises outwardly flaring rigid walls to provide an expanding passage for acoustic energy between a throat and a mouth. The acoustic horn is stimulated by a source driver unit which produces acoustic energy, and the acoustic horn then modifies and controls the acoustic energy.

The audio industry has spent many decades on the design of acoustic horns with defined areas of coverage. For instance, 90° in a horizontal plane by 40° in a vertical plane, or 60° by 40°, and so on. Generically they are called constant directivity horns.

A constant directivity acoustic horn generally comprises a throat and a mouth joined by continuous rigid walls wherein the throat couples to a feeder section which is rectangular in transverse cross-sectional shape with acoustical energy being coupled thereto from a source driver unit. The feeder section has an expanding transverse area formed by a first pair of walls which diverge outwardly from each other, and a second pair of walls which are substantially parallel and joined to the first pair. The mouth of the horn has a rectangular configuration and is formed by a bell section having walls which diverge outwardly from the end of the feeder section, there being a first pair of diverging walls, and a second pair of diverging walls which join with the first pair of walls of the bell section along the edges to form an integral unit. The walls of the bell section may be flared outwardly an additional amount at a transverse plane immediately adjacent to the mouth to provide improved control of the radiation of acoustic energy. In general the divergence angle between the first pair of walls

and between the second pair of walls determines the dispersion angle of the acoustical energy. A feature of this geometry is that the side profile view and top profile view angles and the dimensions of the mouth can be varied independently in order to obtain specified outcomes.

Many shapes of constant directivity horns have been evolved over the years to try to achieve a more uniform coverage. Initial attempts were by Olsen with multi-cellular horns, Klipsch (US 2,537,141) with radial sectorial, Keele (US 4,071,112) with the concept of outer flanges, Henricksen et al (US 4,187,926) with a design "in reverse" (Manta Ray), Keele again (US 4,308,932) with profiles specified by a formula, Gunness (US 4,685,532) with throat vanes (pseudo horns). Most of these shapes (e.g. the Manta Ray) which have evolved to meet the need for uniform coverage have other disadvantages, for example, an irregular on-axis frequency response.

SUMMARY OF INVENTION

According to a first aspect of the invention there is provided a directivity controlling acoustic horn assembly comprising:

a source driver unit having a divergent frusto-conical exit for transmission of acoustic energy;

a throat having a circular entrance and a rectangular exit;

a feeder section having a first end and a second end, the first end connected to the exit of the throat; and

a bell section having an entrance and terminating in an open mouth, the entrance of the bell section connected to or integral with the second end of the feeder section,

wherein the throat is shaped such that its profile, through any cross-section longitudinal to the throat, substantially matches the angle of the frusto-conical exit where the frusto-conical exit joins the throat entrance thereby providing a smooth transition from the source driver unit into the throat.

According to a second aspect of the invention there is provided a throat for transmitting acoustic energy from a source driver unit to a feeder section of a directivity controlling acoustic horn, the feeder section having an expanding rectangular cross-section, the throat comprising:

a circular throat entrance connectable to the source driver unit;

a rectangular throat exit connectable to or integral with the feeder section; and

a circular cross-section to rectangular cross-section transition portion extending between the throat entrance and the throat exit,

wherein all tangents intersecting the throat entrance, that are coplanar with the longitudinal axis of the throat, diverge with respect to the longitudinal axis in a direction towards the throat exit.

Specific embodiments of the invention will now be described in some further detail with reference to and as illustrated in the accompanying figures. These embodiments are illustrative, and are not meant to be restrictive of the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side view of a generic constant directivity acoustic horn.

Figure 2 is a front view of the acoustic horn in Figure 1.

Figure 3 is a top view of the acoustic horn of Figure 1.

Figure 4 is a cross-sectional view of a typical source by the unit (a "compression driver").

Figure 5 is a side view of a constant directivity "angular" acoustic horn.

Figure 6 is a top view of the "angular horn" of Figure 5.

Figure 7 is a side view of a constant directivity "curvy" acoustic horn.

Figure 8 is a top view of the "curvy" acoustic horn of Figure 7.

Figure 9 is a side view of a throat of a constant directivity acoustic horn.

Figure 10 is a top view of the throat shown in Figure 9.

Figure 11 is a side view of a throat according to a first embodiment of the invention.

Figure 12 is a top view of the throat of Figure 11.

Figure 13 is a side view of a throat according to a second embodiment of the invention.

Figure 14 is a top view of throat of Figure 13.

Referring to Figures 1, 2 and 3, a generic constant directivity acoustic horn is shown. The acoustic horn comprises a throat to having a circular entrance to I and a rectangular exit to E, a feeder section 3 having an expanding rectangular cross-section ending at a plane indicated by the line 4 and a bell section 5 that terminates in a open mouth 6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In Figure 1 side view, the throat **2i** and the mouth **6** are shown, together with the divergent profile of the first pair of walls **3a**, which is determined by the specified beam angle. The transverse plane at which the feeder section **3** ends is shown by the line **4**. The feeder section is at **3** and the bell section is at **5**.

In Figure 3 top view, the throat **2i** and the mouth **6** are shown, together with the profile of the second pair of walls **3b** of the feeder section **3**. The second pair of walls **5b** of the bell section **5** are also shown. In Figure 2 front view, the throat **2,** the mouth **6,** and the location of the feeder section wall **3b** is shown.

A typical source driver unit 7 is shown as Figure 4. It is known as a compression driver, and is an electromagnetic converter of electrical energy to acoustical energy.

The acoustical energy is generated by movement of the diaphragm **7c**, which is moved by a coil of wire **7e** immersed in the magnetic field of the magnet structure **7m**. The diaphragm assembly is mounted in a circular frame **7f**. The acoustical energy (sound) radiated from the concave side of the diaphragm is guided by a

series of concentric tapered cylinders called a phase plug **7d** into the throat **7t** of the unit. The throat **7t** is frusto-conical in shape and has an exit angle shown as **7i**. Acoustical energy is also radiated from the convex side of the diaphragm **7c**, but is confined by the cover **7a**. The surface **7h** is the mounting surface which attaches to the flange **1** of the horn.

Prior art constant directivity acoustic horns are shown in Figures 5 to 8. In general they have the same features referred to already. The source driver unit is attached to the flange **1**, and passes acoustic energy into the throat entrance **2i**. Note that throat entrance **2i** is usually round in transverse shape to provide a better match to the circular shape of the source driver unit. The acoustic energy then passes through a short section of transition **2a** from round to rectangular and through the feeder section **3** into the bell section **5**. The acoustic energy is guided in the side view plane by profile **3a** and **5a** and in the top view plane by profiles **5a, 5b, and 5c**, depending on whether the acoustic horn has an "angular" or "curvy" appearance.

Enlarged views of the source driver 7 and throat 2 are shown in Figures 9 and 10. In Figure 9 side view, the source driver unit 7 is attached to the flange **1**, and passes acoustic energy into the throat entrance **2i** of the acoustic horn and through the round to rectangular transition region **2a**. The feeder section **3** is shown, as is the profile of the first set of walls **3a**. The exit taper angle **7i** on the throat of the source driver unit **7** shows a discontinuity **10a** compared to the profile of the first set of walls **3a**.

In Figure 10 top view, the source driver unit **7** is attached to the flange **1** and passes acoustic energy into the throat entrance **2i** of the acoustic horn and through the round to rectangular transition region **2a**. The exit taper angle **7i** on the throat of the source driver unit **7** shows a discontinuity **10d** compared to the profile of the second set of walls **3b**.

Improved constant directivity acoustic horns according to first and second embodiments of the invention are shown in Figures 11 to 12 and 13 to 14 respectively.

These acoustic horns comprise a throat and a mouth joined by continuous rigid walls. The throat entrance couples to a transition region which is circular in transverse shape and thence to a feeder section which is rectangular in transverse shape bounded by two pairs of walls with acoustical energy being coupled throughout from the source driver unit. The transition section has an expanding transverse area and walls which have an initial angle to match the exit angle of the source driver unit. The profile of the first pair of walls has an initial angle to match the exit angle of the source driver unit, and then smoothly changes to the appropriate angle for the desired beam angle. The second pair of walls have an initial angle to match the exit angle of the source driver unit and smoothly diverge and then smoothly converge in such a manner in the transition region that an appropriate transverse area is maintained while the shape of its transverse section smoothly changes from circular to elliptical to rectangular. The second pair of walls then continues, being substantially parallel, and being joined to the first pair of walls which diverge outwardly from each other.

The mouth of the horn has a rectangular configuration and is formed by a bell section having walls which diverge outwardly from the end of the feeder section, there being a first pair of diverging walls, and a second pair of diverging walls which join with the first pair of walls along the edges to form an integral unit.

The walls of the bell section may be flared outwardly an additional amount at a transverse plane immediately adjacent to the mouth to provide improved control of the radiation of acoustic energy. In general the divergence angle between the first pair of walls and between the second pair of walls determines the dispersion

angle of the acoustical energy. A feature of this geometry is that the angles apparent in the side view and top view and the dimensions of the mouth can be varied independently in order to obtain specified outcomes.

Figures 11 and 12 show a first embodiment of the invention. In Figure 11 side view, the source driver unit **7** is attached to the flange **1** and passes acoustic energy into the throat entrance **2i** and through the round to rectangular transition region **2a** into the feeder region **3.** The profile of the first pair of walls **3a** has an angle of commencement **11a** which matches the exit angle **7i** of the driver source unit. The profile smoothly changes through **11b** to that desired for the beam angle **11c**. The acoustic energy then passes into the feeder region **3**, where the second pair of walls are substantially parallel.

In Figure 12 top view, the source driver unit **7** is attached to the flange **1** and passes acoustic energy into the throat entrance **2i** and through the round to rectangular transition region **2a** into the feeder region **3.** The profile of the second pair of walls **3b** has an angle of commencement **11d** which matches the exit angle **7i** of the source driver unit. The profile then smoothly changes through **11e** and **11f** to that of **3b.** A feature of this change is that the appropriate transverse area is maintained while the shape of its transverse section smoothly changes from circular to elliptical to rectangular. The acoustic energy then passes into the feeder region **3**, where the second pair of walls is substantially parallel and the first pair of walls diverge.

A second embodiment of the invention is shown in Figures 13 and 14. In Figure 13 side view, the source driver unit **7** is attached to the flange **1** and passes acoustic energy into the throat entrance **2i** and through the round to rectangular transition region **2a** into the feeder region **3.** The profile of the first pair of walls **3a** has an angle of commencement **11a** which matches the exit angle **7i** of the driver source unit. The profile smoothly changes through **11b** and **11c** to that desired **3a**

for the beam angle. The acoustic energy then passes into the feeder region **3**, where the second pair of walls are substantially parallel. The size of the aperture at **11c** can be made arbitrarily smaller than the exit size of the source driver unit, giving a better dispersion of high frequency acoustic energy into the acoustic horn. In Figure 14 top view, the source driver unit **7** is attached to the flange **1** and passes acoustic energy into the throat **2i** and through the round to rectangular transition region **2a** into the feeder region **3.** The profile of the second pair of walls **3b** has an angle of commencement **11d** which matches the exit angle **7i** of the source driver unit. The profile then smoothly changes through **11e** and **11f** to that of **3b.** A feature of this change is that the appropriate transverse area is maintained while the shape of its transverse section smoothly changes from circular to elliptical to rectangular. The acoustic energy then passes into the feeder region **3**, where the second pair of walls are substantially parallel and the first pair of walls diverge.

While the present invention has been described in terms of preferred embodiments in order to facilitate better understanding of the invention, it should be appreciated that various modifications can be made without departing from the principles of the invention. Therefore, the invention should be understood to include all such modifications within its scope.

Dated this 17th day of September 2002.

KRIX LOUDSPEAKERS PTY LTD
By their Patent Attorneys
MADDERNS

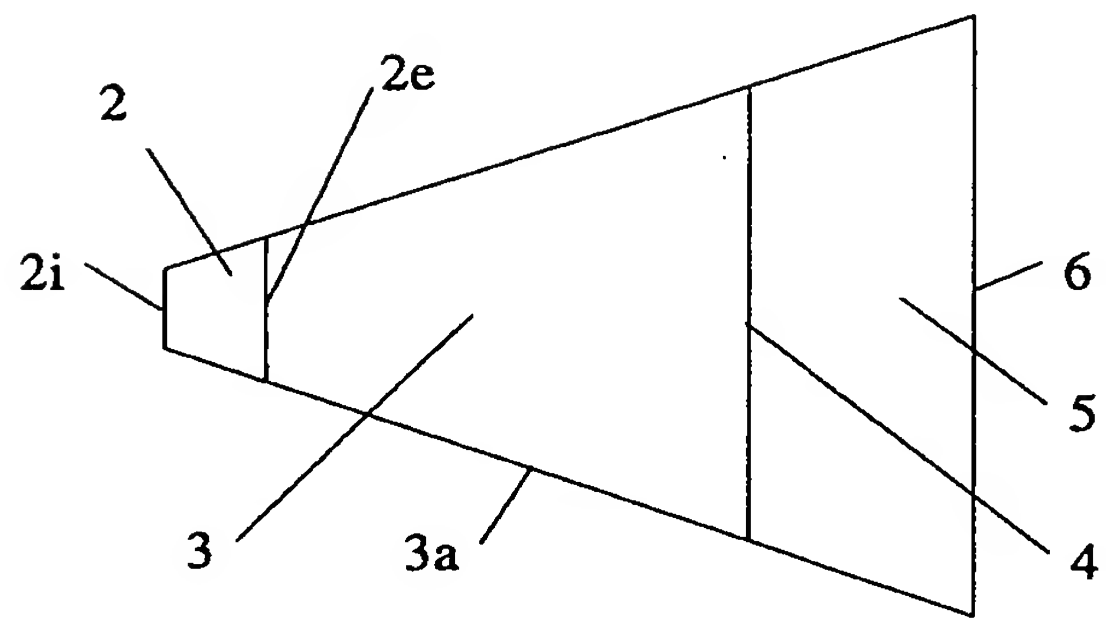

Figure 1

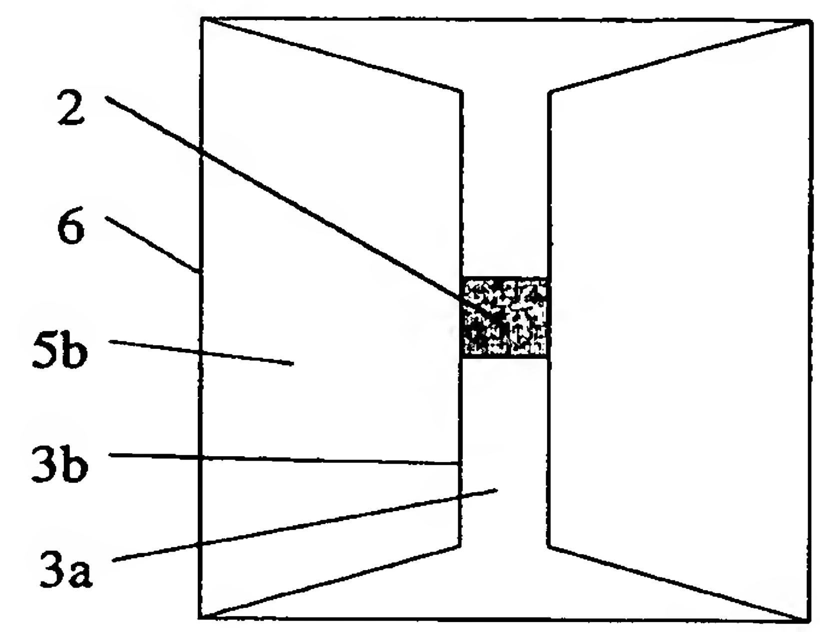

Figure 2

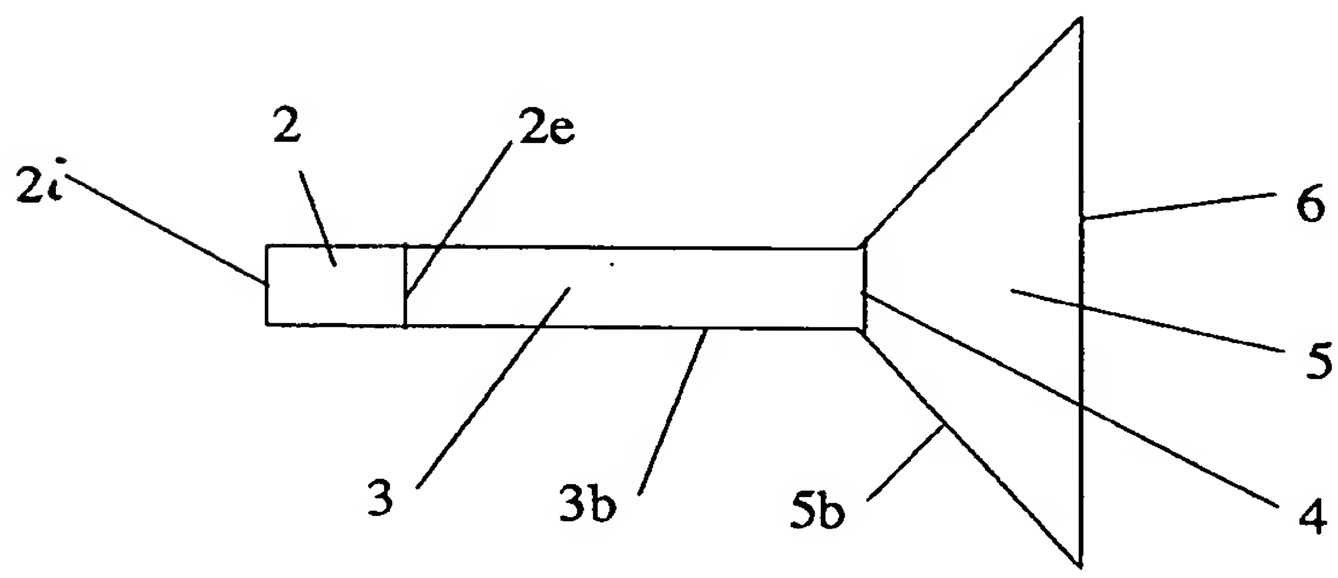

Figure 3

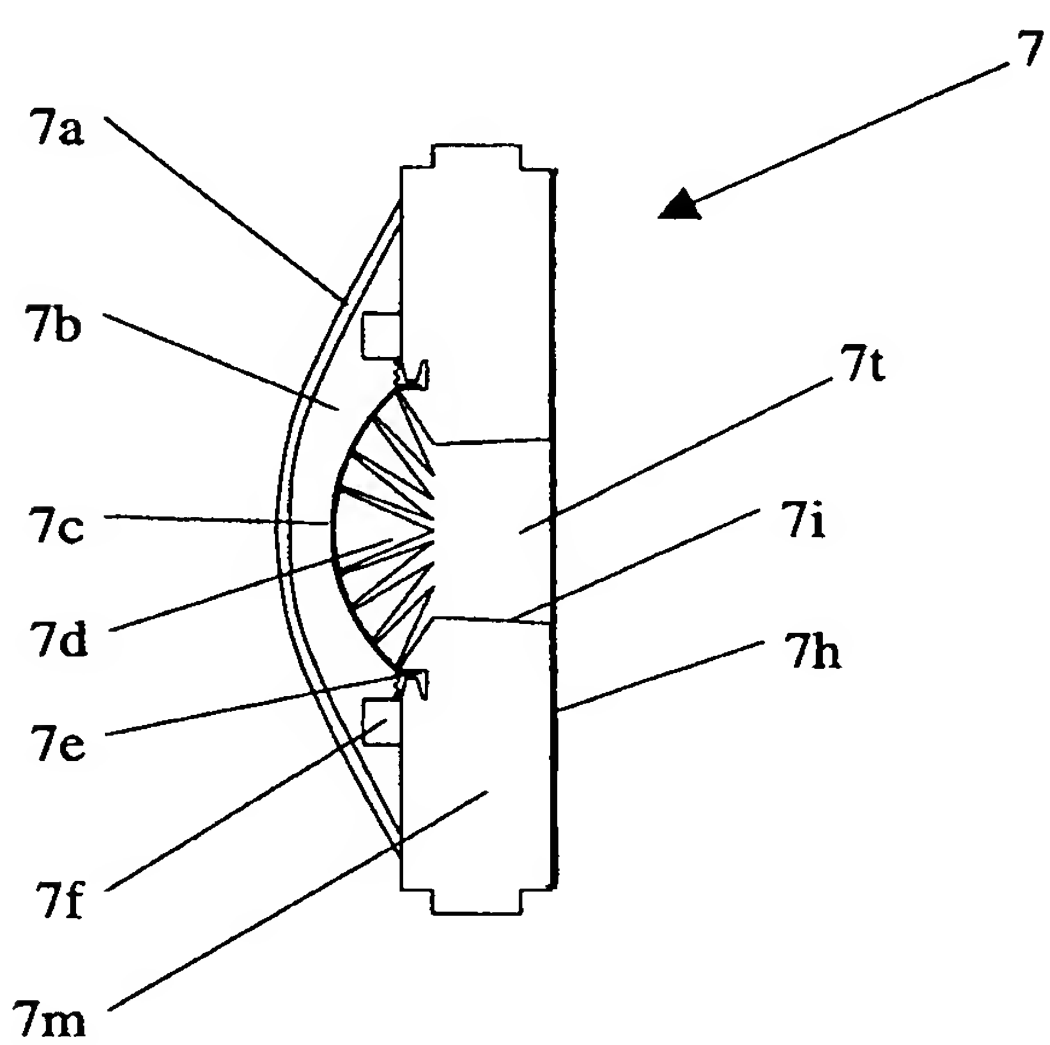

Figure 4

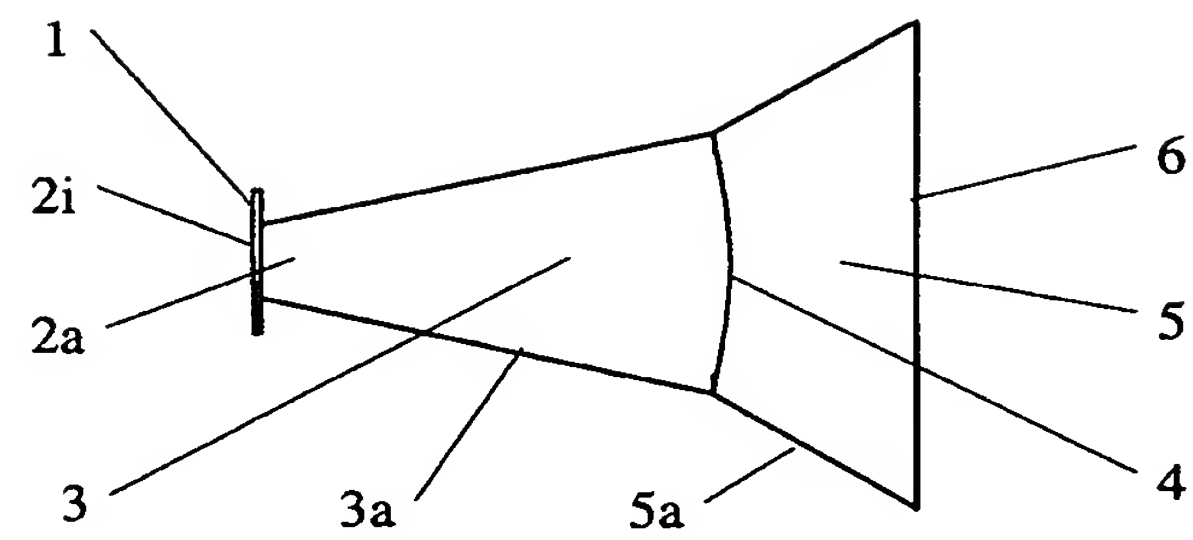

Figure 5

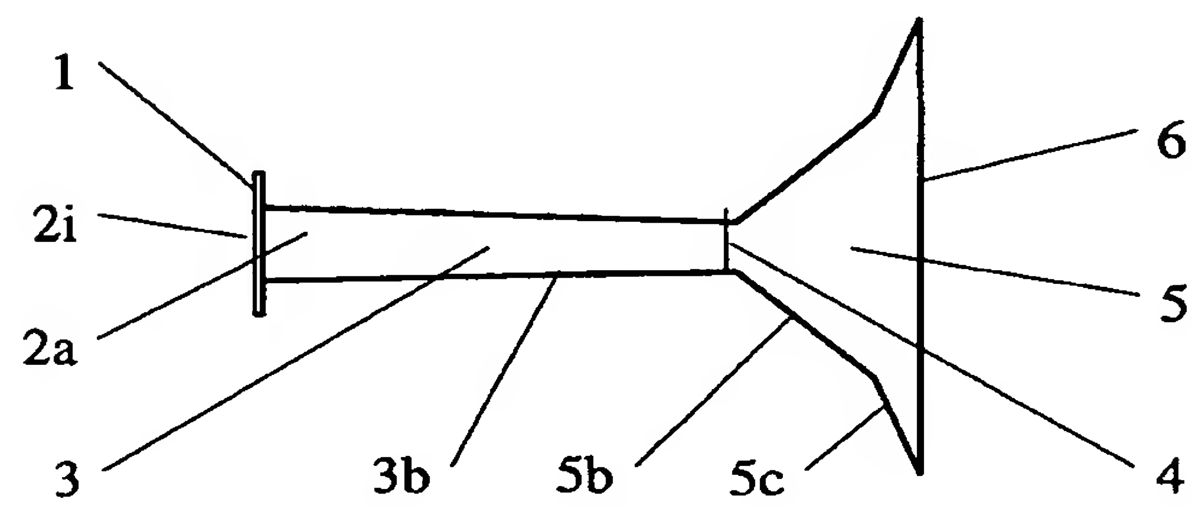

Figure 6

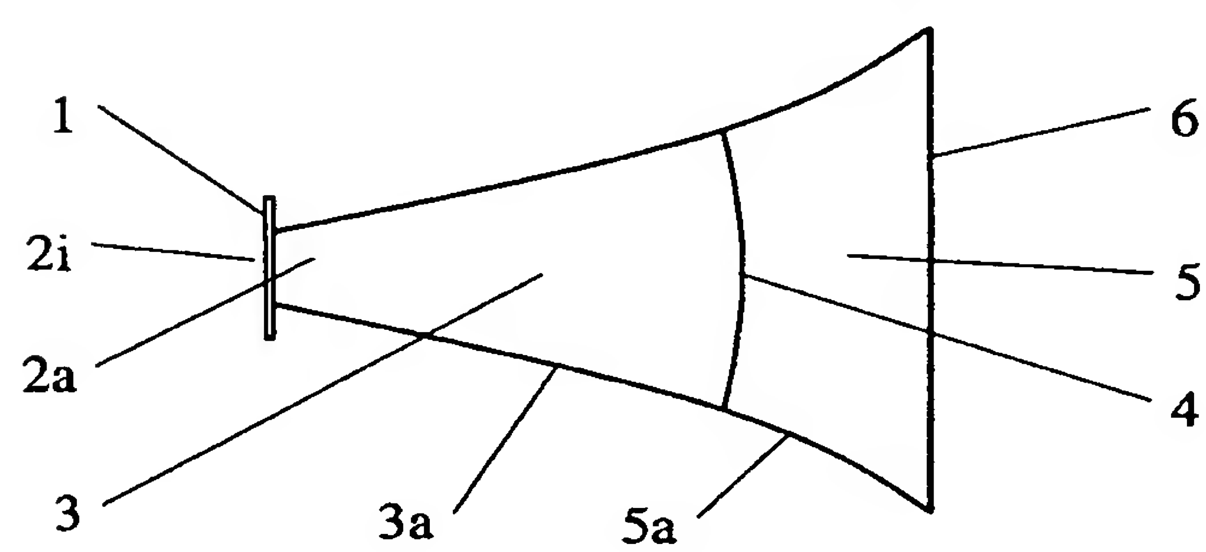

Figure 7

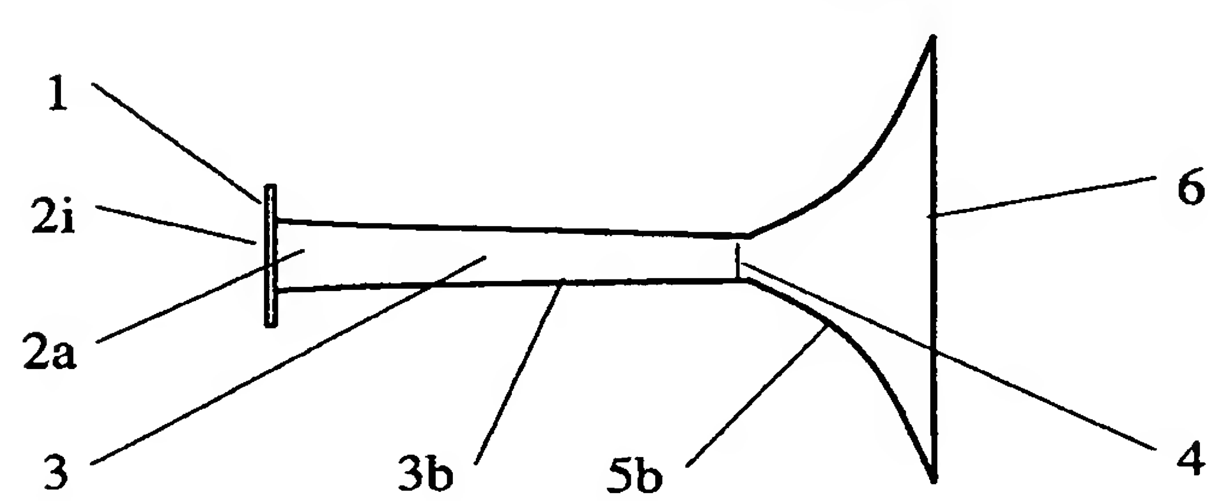

Figure 8

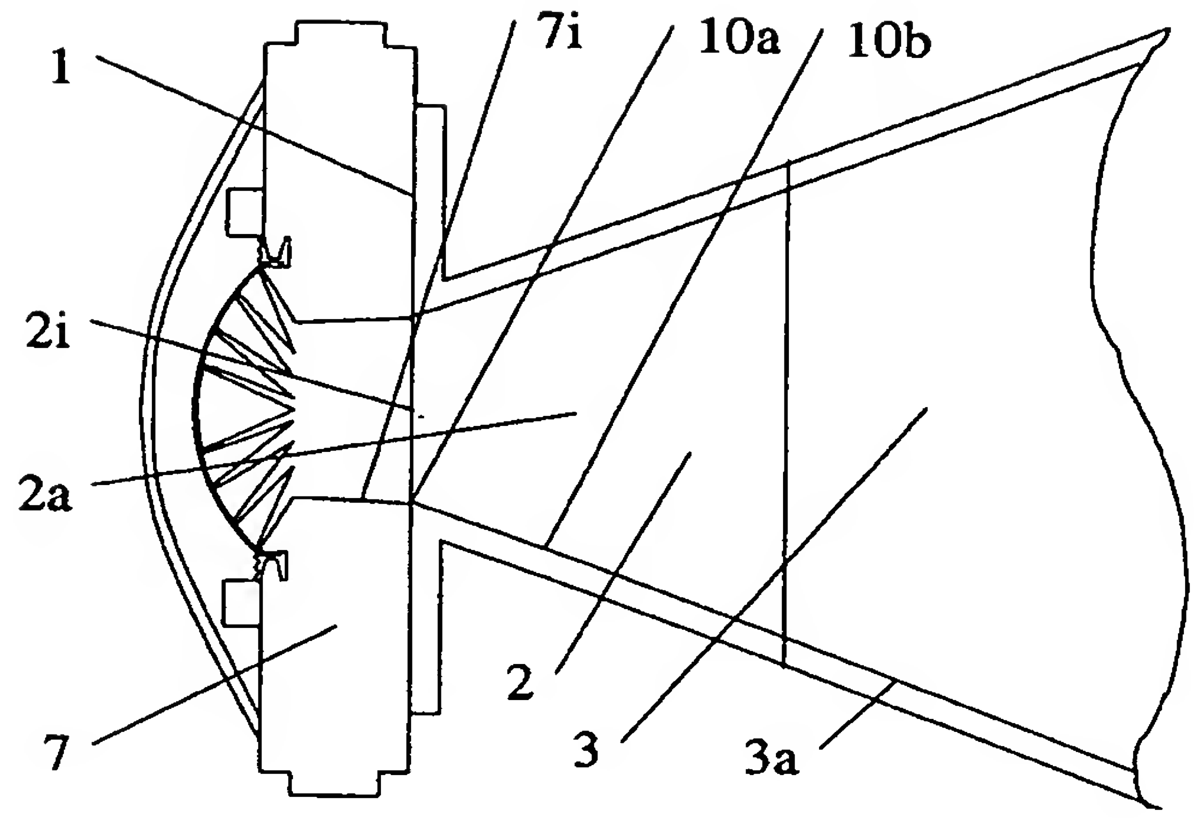

Figure 9

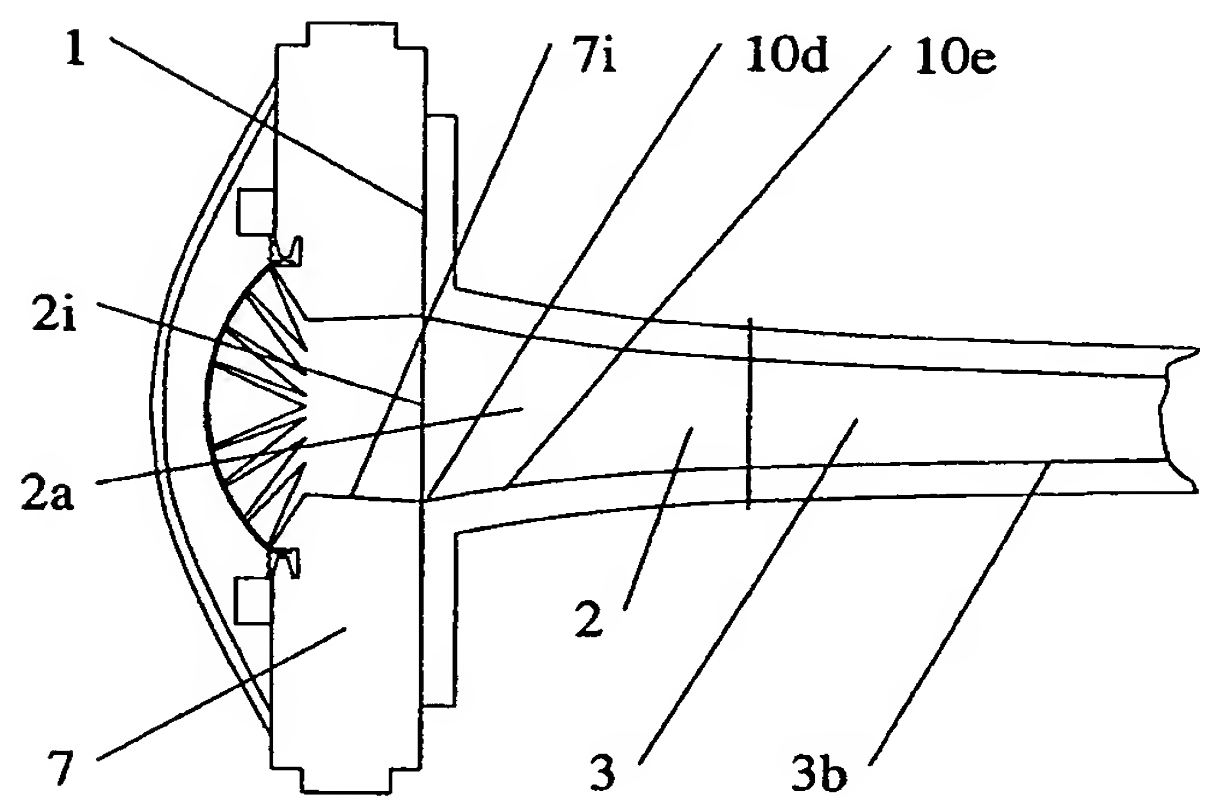

Figure 10

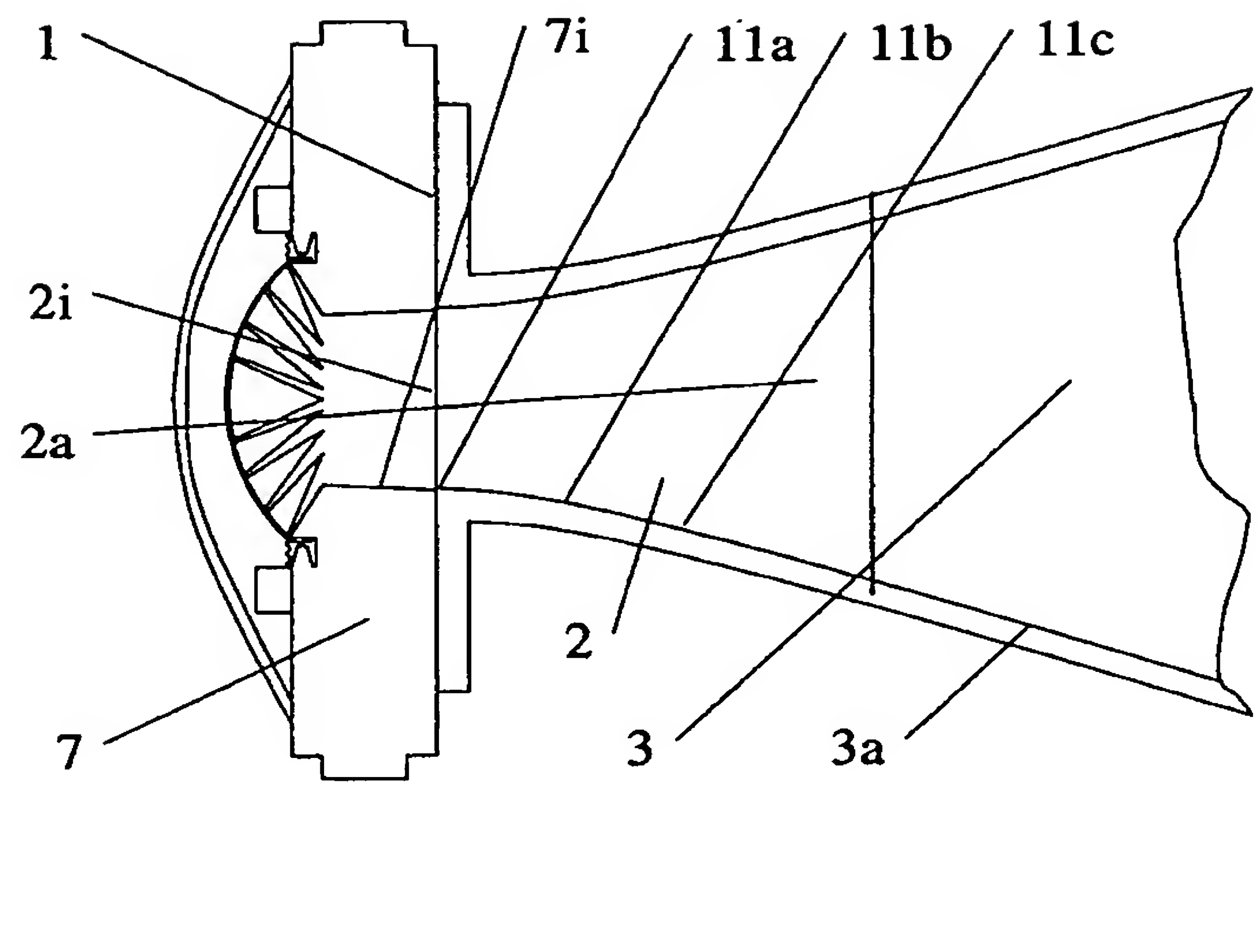

Figure 11

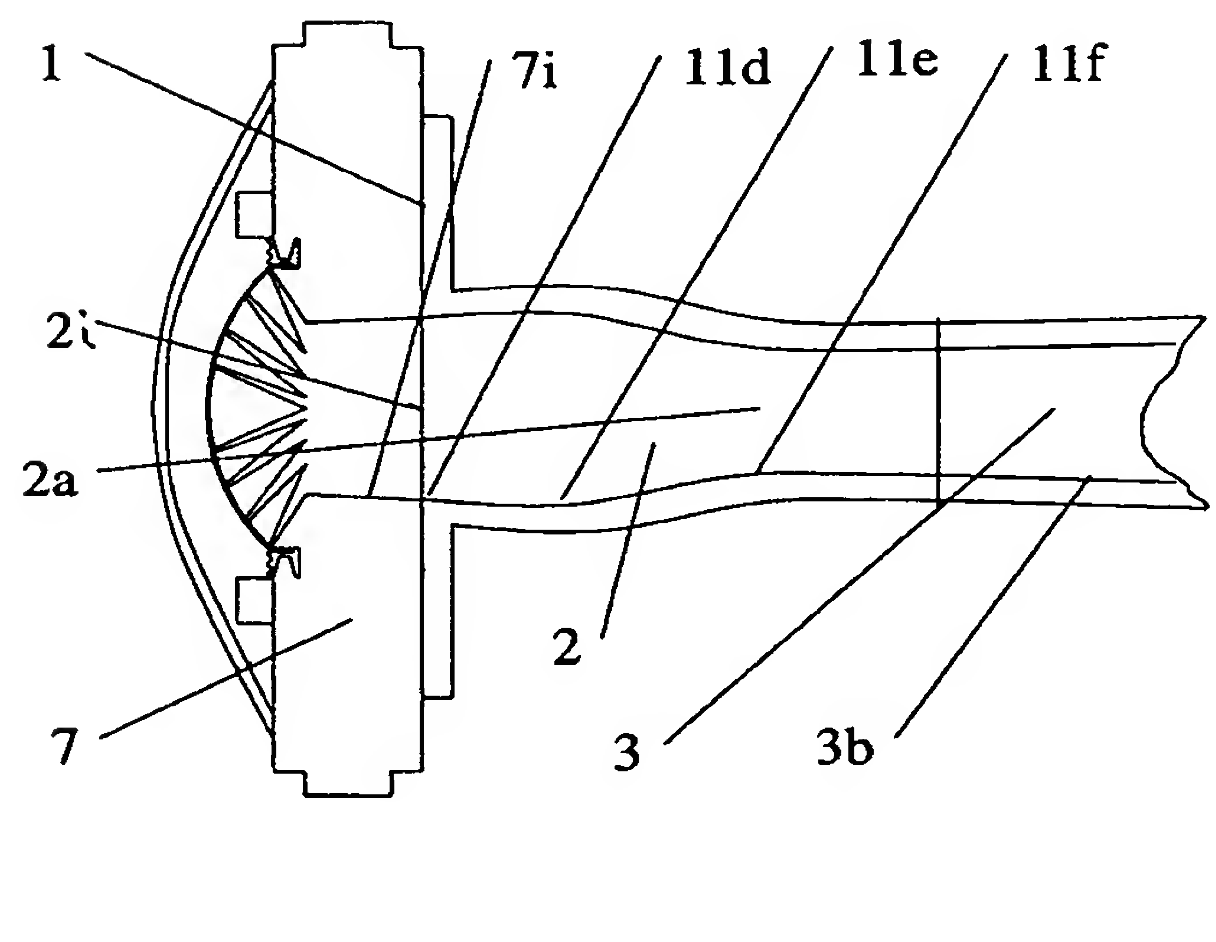

Figure 12

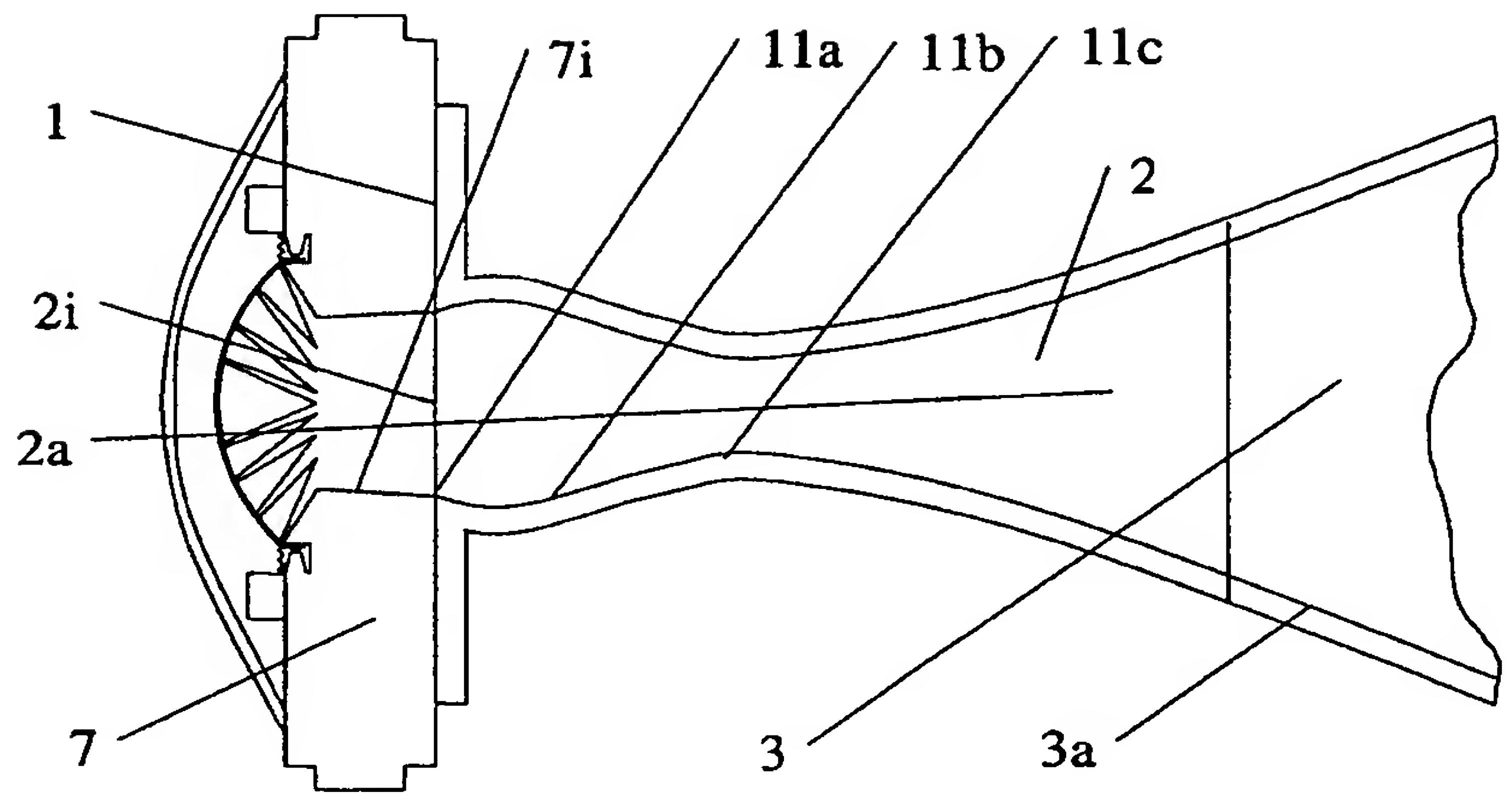

Figure 13

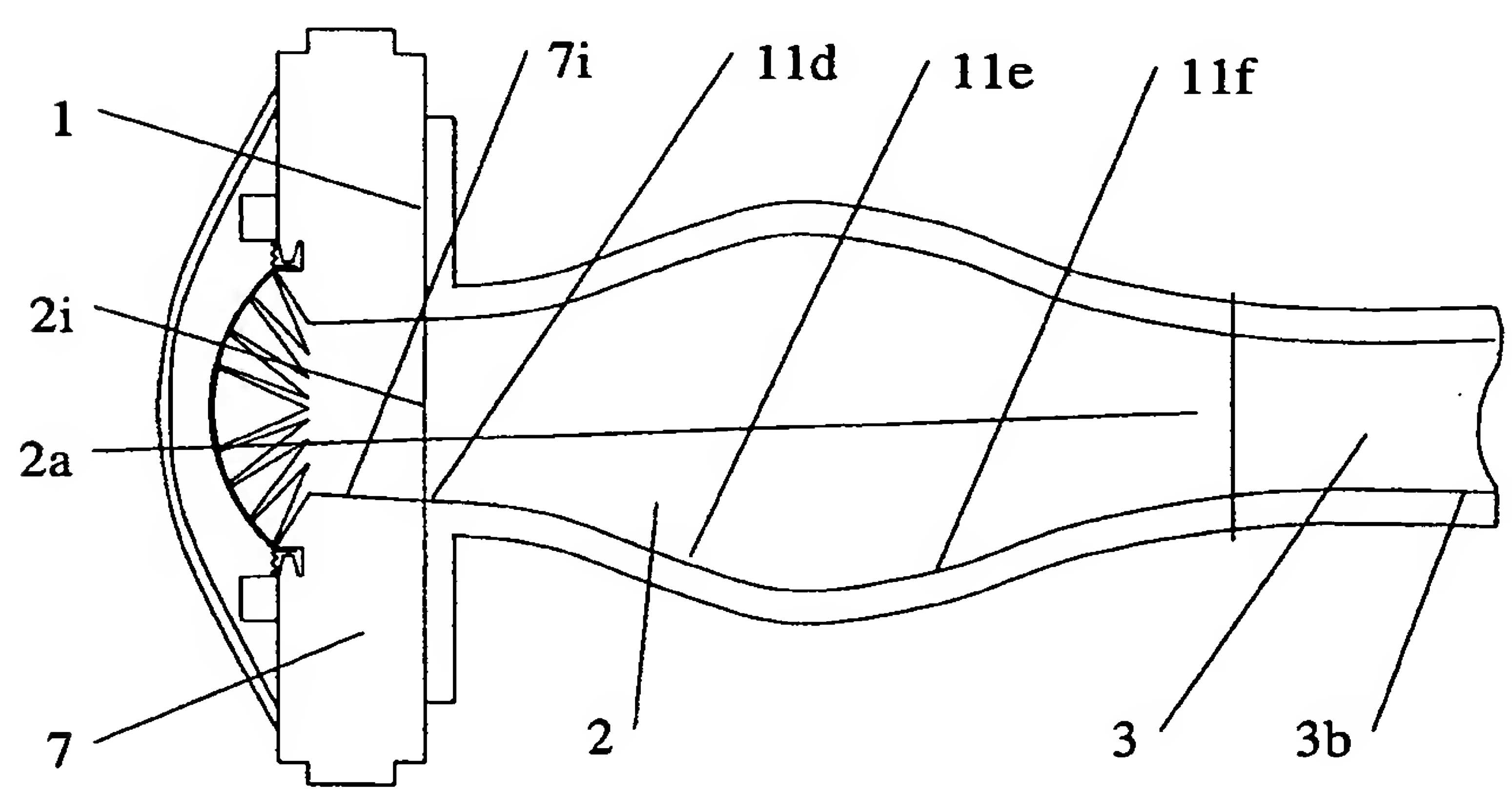

Figure 14